STATEMENT OF NEAL A. BLAKE, DEPUTY ASSOCIATE ADMINISTRATOR FOR ENGINEERING, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS, CONCERNING AIRPORT TECHNOLOGY, JULY 28, 1986.

Mr. Chairman and Members of the Subcommittee:

I appreciate this opportunity to review the areas covered by our Research, Engineering and Development (R,E&D) Program in airport technology and capacity. I believe that these programs will provide the improvements needed to increase airport capacity and the design guidelines that will permit future airports to operate productively. Today I would like to address some of the topics that were included in your letter of invitation.

In looking ahead to the 21st century, we expect the types of aircraft to be much as they are today but with several significant changes. A next generation fuel efficient aircraft, most probably powered by advanced turboprop engines, is expected to enter the fleet starting in the mid-1990 time period. The continued introduction of present generation quieter aircraft is expected to reduce the number of aircraft meeting the older noise standards from 79.6 percent (1985) to 11 or less by 2005.

For the longer term, NASA is exploring the feasibility of developing an economical long-range supersonic transport capable of flight legs up to 5,000 miles. Work is also underway on a transatmospheric vehicle capable of flying from Denver to Sydney in 2 hours. Both of these new aircraft types will be designed to operate into existing major airports. Since Dr. Raymond Colladay of NASA is addressing the future aircraft area, I will not go into that subject any further.

Domestic air carrier revenue passenger miles are forecast to increase at an average annual growth rate of 4.2 percent during the 1985-2005 time period. Domestic enplanements are forecast to increase by 4.4 percent annually during the same period. Air carrier aircraft operations are forecast to increase at an annual rate of 2.1 percent over the forecast period. The high growth in revenue passenger miles and enplanements relative to operations reflects the baseline air carrier assumptions of higher load factors, larger seating capacity for air carrier aircraft, and longer passenger trip lengths.

The FAA forecast for aircraft operations at large hub airports shows a projected growth for Denver airport for the period 1984 to the year 2000 of about 31 percent.

The FAA is pleased to note that Denver is planning to build a totally new airport to provide the facilities needed to accommodate future growth in this area. It also provides the opportunity to incorporate the latest design features and technology into the new design.

Today I would like to review briefly some of our programs in the airport capacity, airport technology, and weather areas which have the potential for providing future improvements in capacity and safety.

The FAA program addresses factors which limit system and airport capacity. The first is the requirements for separation, in the air and on the airport, largely imposed by the overriding requirement for safety. The separation standards have a major impact on capacity in the airspace, the terminal area, and on the airport itself. Safe reductions of separation standards based on better navigation, better surveillance, or better communications can yield dividends in the immediate airport vicinity. It is a major source of airport capacity improvement at existing airports.

The second area concerns variability in aircraft performance, again in the airspace and on the airport. Runway occupancy time variation, variation over the threshold, and variability of aircraft performance in the air constrain achievable capacity; reductions in variability increase it.

Finally, system capacity is limited by the quality and availability of information for management of resources, both in the aircraft and in the air traffic control system. Timely information on aircraft location, current and predicted capacity limits, winds aloft, severe weather, ceiling and visibility limits, sector loading, and a number of other factors establish the level of efficiency of system management. Much of the work we are doing in the National Airspace System (NAS) Plan concentrates on the improvement in the quality and timeliness of information and information flow, because it, perhaps more than any other factor, determines the efficient utilization of available capacity.

The goals for the capacity improvement program, therefore, are to safely reduce separation standards, reduce variability of performance, and to better manage resources to increase system capacity through improved procedures, better surveillance, navigation, and control systems, and new and improved information processing systems.

Perhaps the most extensive NAS Plan program is the Advanced Automation System. In the near term, it will improve FAA's air traffic control computer system capacity, reliability, availability, and expandability. It will improve the controller's interface with the system through improved displays and data entry terminals.

The Advanced Automation System will initially include not only new software and a new controller's sector suite but will also include the initial capabilities of the Automated En Route Air traffic control program (AERA I). It will enable users to fly their preferred trajectories far more of the time. A related capacity improvement is the effort to utilize reduced vertical separation above flight level 290 and continued examination of the potential for reduced horizontal separation.

In a joint program with NASA, we are working toward a system that will permit aircraft to utilize their growing 4-D capabilities to meet metering schedules in order to make best use of the capabilities becoming available in a number of aircraft.

One of the tasks we are planning to undertake in this area is to assure that we can efficiently accommodate aircraft with 4-D area navigation capabililty, and to establish the optimal dynamic control of approach and landing times by automatic communications between 4-D equipped aircraft and the ground system, to establish the best dynamic balance between the operator's wishes and the efficient use of the airport.

R,E&D is planned to follow-on to this beginning of air traffic control automation to improve the degree to which user preferred trajectories can be achieved, based on better knowledge of airport capacity estimates and predictions. To the degree that the information quality permits us to do it, the second phase of the automated en route air traffic control program (AERA II) will analyze flight plans and associated surveillance data to identify, for controllers, alternative solutions for resolving airspace and aircraft conflicts, and later, in AERA III, to analyze flight plans and associated surveillance data to data link computer-generated clearances automatically -- first at high altitudes and then moving down to the lower altitudes and into the terminal environment. This automation effort is expected to result in one of the largest increases in system productivity and capacity that the NAS Plan promises. It will require full exploitation of digital data link.

The Traffic Management System, an extension of the Central Flow Control Facility and the System Command Center, is a program of major importance as part of the NAS Plan System modernization. The Traffic Management System is viewed by some as a mechanism for constraint, rather than capacity enhancement, but constraint is not its purpose. Its purpose is to smooth the flow of traffic to achieve the highest system efficiency, taking into account the real limitations on system and airport capacity and the need to manage flows to permit optimal aircraft operation for everyone. The key to efficient flow management is information on winds aloft, weather--current and predicted, on current and projected sector loading and, perhaps most importantly, clear knowledge of current and projected near-term airport capacity. The degree to which time-based air traffic control can be achieved depends entirely on the quality of information available to the Traffic Management System. The R,E&D required for the near term is to achieve a Traffic Management System which matches traffic demand to available terminal and en route capacities.

One of the most difficult parts of the Capacity Improvement Program relates to the major airports and the terminal areas serving them. One of the tasks is to assure a solid bridge between en route operations and terminal area/airport operations in order to optimize the performance of the total system. We want to accommodate more aircraft per hour, eliminate wasted capacity by reducing variability, and to develop improved information processing systems to manage system resources better. The FAA has been working in this area for a long time.

However, before describing our projects, it is important to emphasize that the biggest capacity gains are achieved from more runways and more airports. Our attempt to equalize VFR and IFR capacity, and some of the projects I will describe, each offer relatively small percentage gains. However, they are worthwhile if you keep in mind that even a small increase in capacity can result in as much as a 5 to 1 reduction in delay costs at an airport nearing congestion.

The first is the reduction of longitudinal arrival spacing between certain aircraft pairs, applicable at airports where runway occupancy times have been found to be less than 50 seconds. We believe 2.5 miles can be achieved for certain IFR operations. A formal data collection for demonstration of this capability has been conducted for both dry and wet runway conditions. Our initial 500 data pairs at three airports (Dallas/Fort Worth, Atlanta, and Newark) have resulted in no-go arounds and no reports of wake turbulence, and only one pilot declined to participate in the demonstration. We hope to implement the reduced longitudinal separation standards for certain aircraft in the medium weight class in the near future.

Independent IFR operations to closely spaced parallel runways - reducing the required separation from the current 4,300 feet to 3,000 feet or potentially even less - have immediate application at 10 airports, and several additional airports are likely to build new runways if they can be used as independents. The FAA analysis, strongly supported by almost the entire industry, led to a real-time simulation conducted by the FAA Technical Center using Memphis where the separation between two parallel

IFR runways is 3,400 feet. The simulation confirmed that this separation is feasible for independent IFR operations if a better sensor is used than the present ASR. Using a modified Navy/Marine Corps radar, we conducted a 6-month demonstration to validate the width of the normal operating zone (NOZ) which determined the safe minimum. Based on this data from Memphis, we hope to extrapolate to determine the adequacy of the procedure and the requirement for surveillance quality to achieve 3,000 feet-separated independent parallel IFR operations.

Also based on an earlier study, a preliminary study of IFR converging approach criteria has been completed. Sixteen of the top 40 airports are candidates for IFR approach minimums reduction for converging runways. The work has proceeded to the development of a first criterion on which improved IFR converging operations can be authorized. The FAA hopes to issue the revised procedure for implementation in the near future. Another aspect of this work is the development of a single criterion on which converging approach operations can be judged. The approach to that single criterion is about to go into coordination with the Industry Task Force. There is follow-on work which would establish the requirements to achieve converging approach minimums similar to those for Category I precision approaches, but that work remains to be done.

A strawman concept for triple IFR approaches is ready for consideration by the Industry Task Force. The work on triples is in series with the work on parallels and converging approaches since triple operations often involve two parallels and one converging runway. The technical analysis here must concentrate on aircraft navigation performance and the missed approach and blunder possibilities during triple operations. While the concept applies to only a few airports at the moment, the lack of procedures for such operations discourages airport operators from planning for them in the future.

Nearly 70 of the top 101 airports have short, often converging runways. Eleven of the top 30 could benefit from enhanced use of the short runways for aircraft with slower approach speeds and shorter runway requirements than those required for large aircraft. Site-specific analysis is required to establish the best use of separate arrival and departure streams and optimal separation to make beneficial use of short runways. The Microwave Landing System (MLS) will have a major beneficial impact. Full short runway utilization will be dependent on implementation of other concepts being considered in the converging and parallel triple Instrument Flight Rule (IFR) approach programs. Work on each of these is well along.

Airport capacity is, of course, impacted seriously by the requirement for wake vortex separations -- 3, 4, 5 and 6 miles depending on the aircraft pair, as well as wake vortex departure spacing. We are continuing work to find operational means to avoid the capacity penalties resulting from avoidance of the wake vortex hazard.

The Traffic Management System has an important impact on best utilization of airport capacity. We have underway research and development on a departure flow metering system to assure the best bridge between the needs of the airport to flush out airplanes and the capability of the transition and en route system to accept them.

For the longer term, demands on airport capacity will continue to increase, and an all weather airport surface surveillance, guidance, and control system will be required. We are currently procuring airport surface detection radar (ASDE). This program will be extended to evolve a full-scale surveillance, guidance, and control system for the airport surface.

The Mode S data link will play an important role in improvement of near and on airport communications and may serve a valuable role in certain surface surveillance systems. Data link is the best way to convey the massive routine information which the pilot and the controller need about airport operations.

MLS represents a most promising system for facilitating further separation reductions. We believe it will have a role in achieving lower minimums for IFR converging approaches, for triple operations, in the separate short runway applications, and to segregate aircraft in multiple airport environments to reduce interaction.

Today there is limited automation in our terminal operations. We have not demonstrated that machines can juggle the many variables as well as human controllers. Our program will concentrate on ways that initially can help the controller in establishing the best approach paths. We have done some work in this area with two universities.

But we need to go even further. Programs are being initiated to provide increased automation in airport operations. We plan to undertake research and development in several areas:

o Analysis of the potential benefit of highly automated terminal area guidance and control systems.

o Analysis of optimal aircraft control methods to achieve precise threshold crossing times.

o Use of computer-guided approaches, either a computer on the ground, a computer on the aircraft, or a combination of the two.

o Optimize and regularize runway occupancy time, one of the major variables affecting airport capacity.

o Automation of surface traffic movement, including aircraft management to achieve runway occupancy time reduction and standardization.

o Definition of methods of airport/aircraft control/command alternatives, required response times, optimum exiting strategies, establishment of data quality, and update requirements for automatic airport operations.

- o Evaluation of alternative means of providing the necessary surveillance data quality and trade-off studies on different surface sensing systems.

We will continue to examine airport designs to identify improvements that will enhance airport capacity and be compatible with new aircraft at both ends of the spectrum, the rotorcraft and light aircraft at one end and the transonic and hypersonic aircraft we are beginning to talk about.

For a number of years, nearly 65 percent of all Airport Improvement Program (AIP) grant money has been expended on runways and taxiways. The FAA and the Federal Highway Administration have worked in the area of pavement research for many years, but additional work is planned as product improvement and to overcome the not infrequent runway outages for runway repair and rebuilding. The Industry Task Force has strongly recommended work in this area. In order to help identify the most fruitful areas of research, the FAA Airports organization sponsored a project by the Army Corps of Engineers Waterway Experiment Station (WES) to survey and establish a needs statement for this work. A report has been developed and submitted to the Industry Task Force for their consideration. This report is being used in formulating our R&D Program which will continue to support the research on pavement durability and repair and airport safety systems, to complement airport capacity improvement.

It has been noted several times that the achievement of major gains in airport capacity comes from construction of new airports and new runways. Several of the R&D projects covered above encourage such construction. For example, the expanded use of multiple IFR arrival streams encourages new runway construction at existing airports to take advantage of the new concepts. MLS can allow separate access to major airports by general aviation and other MLS-equipped aircraft and this, in turn, will encourage development of separate short runways to facilitate such separate access. The capability to achieve efficient multiple IFR arrival streams will also help in supporting airport designs which take advantage of these capabilities.

It goes without saying that a number of the weather programs will have a direct impact on airport capacity, not only the wake vortex detection and avoidance effort but also the efforts to provide better severe weather and wind shear information and better data on winds aloft and wind on the approach path.

At this time, I would like to summarize some of the highlights of our program to improve the observation, processing, and dissemination of weather information.

o The hazardous in-flight weather advisory system is operational in three air traffic control center areas and will be extended to provide nationwide coverage in 1987. This system provides forecast information on severe weather, in the form of SIGMET's, and current information on severe weather hazards in the form of Center Weather Advisories. This information is generally broadcast over VOR frequencies.

o Use of displays of existing National Weather Service radar by controllers in the air traffic control tower was examined at several towers. This examination indicated that insufficient data was available to identify hazardous weather phenomena existing within the precipitation contours presented on the weather displays. Discussions are in progress with the National Weather Service to determine whether hazardous weather contours could be developed at a National Weather Service facility, transmitted to the weather display in control tower, and presented in near real time to the controllers.

o Significant progress has been made in the wind shear program area. A contract was awarded during 1985 to a team of companies to develop a comprehensive pilot training program in wind shear. This program will develop a course of instruction in the nature of the wind shear hazard, recognition and avoidance of wind shear, and piloting techniques that will provide the best performance from an aircraft should a shear be encountered.

o A joint program has been initiated with NASA Langley on the development of airborne systems for detection of wind shear and for provision of flight guidance to pilots in avoiding or obtaining the best aircraft performance if a shear is encountered. The program addresses several areas. One is the improvement of existing detection systems to determine the degree to which these systems can detect both wet and dry microbursts. One activity is designed to determine the extent to which airborne Doppler weather radar performance can be improved for the detection of microbursts. This is a very difficult task since the radar antenna is small, the transmitter of low power, and the processing to remove ground clutter extremely difficult. A second effort in the sensor area will determine the extent to which laser lidar devices and other technologies can be developed to detect microbursts generally and in particular dry microbursts. Another part of the program addresses improvements that can be made in the flight guidance provided to the pilot during recovery from a wind shear encounter. A related activity is continuing the characterization of the wind shear hazard. This activity will determine the flight guidance improvements needed to account for the effects of the ring vortex properly which forms at the outside edge of the microburst. A future task will address the integration of forward-looking sensors with the improvement in flight guidance to provide a system that will allow the pilots to detect and avoid wind shear conditions.

o The Next Generation Weather Radar (NEXRAD) Program is now in the prototype test phase. The award for limited production systems is expected in January 1987.

o During FY 1986, the two NEXRAD contractors conducted design studies for a terminal variant of the NEXRAD systems. Two of the limited production NEXRAD systems will be delivered with the terminal modifications in place. The remaining 13 terminal variants will be delivered as part of the production contract.

o During 1985, the FAA tested a prototype of the Terminal Doppler Weather Radar at Memphis, Tennessee. This program resulted in the definition of technical parameters including scanning strategies and types of displays and initial testing of the automatic detection and warning algorithms. During the test period which covered the summers of 1984 and 1985, nearly 100 microbursts were detected in the Memphis area. Of these, two occurred in the approach and departure points of the Memphis airport. Approximately 25 percent of the microbursts were dry. In the fall of 1985, the system was moved to Huntsville, Alabama, and will be used during 1986 for further development and testing of the automatic detection and warning algorithms which will ultimately provide microbursts warning to tower controllers. The FAA radar will be operated in conjunction with Project Microburst Severe Thunderstorm (MIST) which is a joint program of the National Science Foundation and the University of Chicago to study microbursts and severe thunderstorm activity in the humid southeast part of the United States.

o Implementation of the Low Level Wind Shear Alerting System at 110 sites is being completed. R&D leading to definition of an enhanced system will be completed this year. The enhanced system will have additional sensors for improved processing, data recording and archiving, and improved display formats. Wind shears will be reported in "along runway" and "across runway" components. We believe this format will be easier for pilots to use.

o In the Automated Weather Observing System (AWOS), we have solved the sensor problems that we had in the past and are currently in the production design phase of the AWOS contract. In addition, we are planning to start a second procurement for additional systems. These systems will be installed at nontowered airports to provide basic meteorological information including wind speed and direction, temperature, dew point, altimeter setting, visibility, cloud height, and precipitation.

o Development of the Central Weather Processor is continuing. This system accepts information from the NEXRAD radars and meteorological products from the National Weather Service and provides processed information to meteorologists. The meteorologist uses the information to prepare aviation short-term forecasts and severe weather advisories. In addition, he generates graphical products identifying weather hazards. The processed products generated both by the meteorologist and by the automatic algorithms will be provided to the controller as an overlay on the air traffic control display and to the pilot via the Mode S data link.

o In addition to the program efforts I have just described, Dr. McCarthy of the National Center for Atmospheric Research, working with a group of technical experts, completed a report during 1986 which provided a number of recommendations covering the areas of pilot weather training and near-term improvements in forecasting, particularly as they relate to severe weather hazards. The FAA will be reviewing these recommendations with a view toward implementation of needed improvements, particularly in the short-term forecast area.

Finally, because of the interest in aviation security, we are continuing research in advanced explosive detection systems for baggage and cargo inspection, improved concourse security through an integrated system, explosive vapor detection sytems for detection of explosives and flammable liquids carried by passengers, and the best methods of handling bombs discovered after the aircraft is in flight.

The FAA is developing and evaluating an advanced generation thermal neutron detection for baggage and cargo inspection. A chemiluminescent vapor detection system is under evaluation and will be combined with an existing passenger portal system in FY 1987. In addition, advanced detection concepts are being evaluated. Promising techniques will be developed and tested.

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